Fiscal Policy in a Two-Sector Model of a Small Open Economy

Juha Tervala*
Department of Economics, University of Helsinki

Discussion Paper No. 619:2005
ISBN 925-10-1556-X, ISSN 1459-3696
June 21, 2005

Abstract

This paper analyzes the macroeconomic effects of fiscal policy in a small open economy under a flexible exchange rate regime. This paper lays out a tractable two-sector model that offers simple and intuitive predictions on how fiscal policy affects the economy, and how the effects of fiscal policy depend on the elasticity of substitution between traded and nontraded goods. The numerical solution of the model is used to show that the sign of the current account response to fiscal policy depends on the interplay between the intertemporal elasticity of aggregate consumption and the elasticity of substitution between traded and nontraded goods. The elasticity of substitution between traded and nontraded good is also a key variable to explain exchange rate behaviour. This study reveals that, under a specific parameterization, a one percent rise in government spending increases the short-run output of nontraded goods by more than one percent also in the case where the exchange rate appreciates. In addition, it is demonstrated that fiscal policy is the most expansionary in the case where the equilibrium real exchange rate appreciates the most. Finally, it is shown that the short-run effects of fiscal policy largely depend on whether a rise in government spending is temporary or permanent, and that only permanent changes generate current account imbalances.

Keywords: Fiscal policy, exchange rate, current account, new open economy macroeconomics

JEL classification: E62; F31; F32; F41

---

*Department of Economics, P.O. Box 17, FI-00014 University of Helsinki, Finland; Email: Juha.Tervala@helsinki.fi. I would like to thank Pertti Haaparanta, Kari Heimonen, Heikki Kauppi, Klaus Kultti, Tapio Palokangas, Christian Pierdzioch and Mika Widgrén for useful comments. Financial support from the Yrjö Jahnsson Foundation and the Finnish Cultural Foundation is acknowledged with thanks.

1 Introduction

This paper studies the macroeconomic effects of balanced-budget fiscal expansion in a small open economy under a flexible exchange rate, assuming that the government spends exclusively on domestically produced goods. The motivation for this research comes from the observation that the literature on the new open economy macroeconomics[1] (NOEM) has focused almost exclusively on two-country global models and the analyses of the macroeconomic effects of fiscal policy on small economies are almost completely ignored. In choosing a small country setting, the present paper focuses on a simpler model, but it brings in interesting insights into the effects of fiscal policy in open economies. The primary focus is to examine how the effects of fiscal expansion depend on the elasticity of substitution between traded and nontraded goods. To address this research agenda we develop a simple model in which the elasticity of substitution between traded and nontraded goods is not restricted to a particular value even if the model is numerically solved. Relatively few studies have examined the effects of fiscal policy in calibrated versions of NOEM models. For example, Kim and Roubini (2004, 11) point out that "[t]he effects of fiscal policy on the current account and the real exchange rate in calibrated versions of these NOEM models are still waiting to be analyzed."

One of the biggest advantages of the NOEM framework, pioneered by Obstfeld and Rogoff (1995, 1996 Section 10), is that it "incorporates the price rigidities essential to explain exchange rate behavior without sacrificing the insights of the intertemporal approach to the current account" (Obstfeld – Rogoff 1995, 624). The model presented in this paper uses the strengths of the NOEM framework by deriving the short-run and long-run effects of fiscal expansion not only on the exchange rate and the current account but also on several other macroeconomics variables. The model builds on the monetary policy model developed by Lane (2001a). His model extended the small-country model contained in the Appendix to Obstfeld and Rogoff (1995) by introducing a utility function that is non-separable between tradables and nontradables consumption. The main advantage of this specification of preferences is that in this framework economic shocks to the nontraded goods sector affect tradables consumption and

[1] See Lane (2001b) for an excellent survey on the NOEM literature.

consequently the current account. This framework, therefore, is well equipped to study the effects of fiscal policy on the optimal time path of consumption and external borrowing.

As Kim and Roubini (2004) point out, a broad range of models: traditional Keynesian models, optimizing models and Real Business Cycle models, suggest that fiscal expansion induces a worsening of the current account and an appreciation of the exchange rate in the short run. Some models, of course, have shown that fiscal expansion has not to worsen the current account and depreciate the exchange rate. More recently, the NOEM literature has shown that fiscal expansion can be associated with a depreciation of the exchange rate and an improvement of the current account. In the Obstfeld-Rogoff model (1996 Section 10),[2] a balanced-budget rise in government spending depreciates the nominal exchange rate and increases domestic output. If a rise in government spending is temporary, the economy runs a current account deficit in the short run. However, in the case of permanent rise in government spending the economy runs a current account surplus.

The model brings in important insights into the effects of fiscal policy in small open economies under flexible exchange rates. According to our calibration results, under a specific parameterization, a one percent rise in government spending raises the short-run output of nontraded goods by more than one percent in the case where the nominal exchange rate appreciates thereby encouraging consumption substitution from nontraded to traded goods. The intuition behind this result is that in this case the consumption-based real interest rate is temporarily low relative to its future value, which in turn encourages the agents to switch consumption from the future to the present. This intertemporal substitution effect dominates thus increasing consumption of nontraded goods in spite of the appreciation of the nominal exchange rate. It is also shown that permanent fiscal expansion is the most expansionary in the case where the long-run real exchange rate appreciates the most. In addition, it is demonstrated that the sign of the current account response to permanent fiscal expansion depends on the interplay

[2] I present the textbook version (1996) of the model. The only difference is that in the article version of the model a permanent rise in government spending generates a current account surplus in short run if the price elasticity of demand plus one is larger than the inverse of the consumption elasticity of money demand. Since the textbook version assumes that the inverse of the consumption elasticity of money demand is one, this condition is always satisfied.

between the intratemporal elasticity of aggregate consumption and the intratemporal elasticity of substitution between traded and nontraded goods. Finally, it is interesting to perceive that the short-run effects of a rise in government spending differ largely depending on whether a rise government spending is permanent or temporary.

The rest of the paper is organized as follows. Section 2 lays out a two-sector small-country model and then derives the required equilibrium conditions. Section 3 analyzes the macroeconomic effects of a permanent rise in government spending by obtaining an analytical solution of the model in a simple special case. Section 4 solves the model numerically. At first, it briefly discusses the calibration of the model and after that it uses the model to analyze the effects of both temporary and permanent fiscal expansion. It shows how the effects of fiscal expansion vary depending on the elasticity of substitution between traded and nontraded goods. Section 5 provides conclusions.

2 A Small Open Economy Model

In this section, we lay out a small-country two-sector model that is used to analyze the short-run and long-run adjustment of the economy to an exogenous rise in government spending. As mentioned, the model builds on the model by Lane (2001a). The crucial difference between these two models is that this model analyzes the effects of fiscal policy, whereas Lane used the model for an analysis of monetary policy. Lane's main innovation was to introduce a non-separable utility function in consumption of traded and nontraded goods into the small open economy model contained in the Appendix to Obstfeld and Rogoff (1995). The core implication of the nonseparability between traded and nontraded goods consumption is that shocks to the nontraded goods sector induce a spillover effect on consumption of tradables and consequently on the current account.

Next, we describe briefly the main assumptions of the model: market structure, preferences, budget constraints, demand functions, and then derive the required optimality conditions. To study the dynamic effects of fiscal policy we employ a log-linear version of the model. It is assumed that the prices of nontraded goods are sticky in the short run and fully flexible in the long run. The model, therefore, allows for distinguishing the short-run and long-run effects of fiscal policy.

2.1 Market Structure and Preferences

Consider a small-country two-sector model in which the nontraded goods sector is monopolistically competitive and the locus of sticky-price problem. The traded goods sector has a single homogeneous good that is priced in the competitive world market. The home country is inhabited by a continuum of individual agents. The home country size is normalized to unity, thus the agents are indexed by z $\in$ [0,1]. Each agent produces, using his/her own labour as input, a single differentiated perishable nontraded good. Each agent also receives a constant endowment of a homogeneous traded good in each period. As consumers, they consume all goods produced in the home country.

The representative agent is infinitely-lived and maximizes his/her intertemporal utility function

(1) $$U_t = \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{\sigma}{\sigma - 1} C_s^{\frac{\sigma-1}{\sigma}} + \frac{\chi}{1-\varepsilon} \left(\frac{M_s}{P_s} \right)^{1-\varepsilon} - \frac{\kappa}{2} \left(y_{N,s}(z) \right)^2 \right],$$

where

(2) $$C_t = \left[\gamma^{\frac{1}{\theta}} C_{T,t}^{\frac{\theta-1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}} C_{N,t}^{\frac{\theta-1}{\theta}} \right]^{\theta/\theta-1}.$$

In the utility function (1) U_t stands for utility at time t, β ($0 < \beta < 1$) is the discount factor. The first term in (1) is the utility for consumption, where C is the overall consumption index that aggregates consumption of traded and nontraded goods and σ is the intertemporal elasticity of aggregate consumption. In equation (2) $C_{T,t}$ is consumption of tradables at time t, γ is the share of tradables in total consumption, $C_{N,t}$ is the private nontraded goods consumption index (to be defined below) and θ is the elasticity of substitution between traded and nontraded goods. The second term in the utility function (1) reflects the utility for holding real balances, where χ is the positive parameter, M_s is nominal money balances held by the agent at time s, P_s is the consumption-based price index (to be defined below) and ε is the money demand parameter. The last term captures the disutility the agent experiences in having to produce output, where $y_s(z)$ is the output of nontraded good z and κ the positive parameter.

The overall consumption index, given by (2), aggregates consumption of traded and nontraded goods. As mentioned, $C_{T,t}$ is consumption of tradables. The variable $C_{N,t}$ is the private nontraded goods consumption index, a CES aggregator of quantities of different nontraded goods consumed:

(3) $$C_N = \left(\int_0^1 c(z)^{\frac{\mu-1}{\mu}} dz \right)^{\mu/\mu-1},$$

where c(z) is consumption of good z and μ (> 1) denotes the elasticity of substitution between varieties of nontraded goods (the parameter also denotes the price elasticity of demand of good z). It is assumed that government expenditures do not affect private utility. Per capita government consumption, G_N, is the government consumption index that aggregated in the same manner as private nontraded goods consumption, and with the same elasticity of substitution

$$G_N = \left(\int_0^1 g(z)^{\frac{\mu-1}{\mu}} dz \right)^{\mu/\mu-1},$$

where g(z) is government consumption of good z.

Home tradables are perfect substitutes with foreign-produced tradables, and the foreign currency price of tradables is exogenously determined in the world market. There are no costs or impediments to trade between the home country and the world market, and thus the law of one price holds in tradables. The foreign currency price of tradables can be normalized to unity, which then implies $P_T = E$, where P_T is the domestic currency price of tradables and E is the nominal exchange rate, defined as the home currency price of the foreign currency. The price of tradables, therefore, also stands for the nominal exchange rate.

Given the level of aggregate consumption, the optimal allocation of expenditures between traded and nontraded goods is given by

(4) $$C_T = \gamma \left(\frac{P_T}{P} \right)^{-\theta} C$$

(5) $$C_N = (1-\gamma) \left(\frac{P_N}{P} \right)^{-\theta} C .$$

In the preceding equations, P denotes the consumption-based price index and P_N denotes the nontraded goods price index. The preceding equations imply that the demands for goods are proportional to aggregate consumption with a proportionality coefficient that is an isoelastic function of the ratio of the goods' price to the consumption-based price index. The consumption-based price index, defined as the minimum expenditure required to purchase one unit of aggregate consumption, is given by

(6) $$P = \left[\gamma P_T^{\theta} + (1-\gamma) P_N^{1-\theta}\right]^{1/(1-\theta)}.$$

The nontraded goods price index, defined as the minimum expenditure required to purchase one unit of a basket of nontraded goods, is given by

$$P_N = \left(\int_0^1 p_N(z)^{1-\mu}\, dz\right)^{1/(1-\mu)},$$

where p(z) denotes the price of nontraded good z.

Making use of the constant-elasticity of substitution nontraded goods consumption index, equation (3), and adding up private and government demands yields the demand curve. The total demand for each nontraded good, therefore, is given by

(7) $$y_N(z) = \left(\frac{p_n(z)}{P_N}\right)^{-\mu} \left(C_N^A + G_N^A\right).$$

This equation simply shows that that the demand for each nontraded good depends on its relative price, the elasticity of demand, and aggregate private and government (per-capita) expenditures.

2.2 Budget Constraints

The intertemporal budget for the representative agent is written, in nominal terms, as

(8) $$\begin{aligned} P_{T,t} B_t + M_t &= P_{T,t}(1+r)B_{t-1} + M_{t-1} + p_{N,t}(z) y_{N,s}(z) \\ &+ P_{T,t}\bar{y}_{T,t} - P_t C_t - P_{N,t}\tau_t \end{aligned},$$

where B_t denotes the stock of riskless real bonds (denominated in tradables) held by the agent entering period t + 1. M_t is the agent's money balances entering period t + 1, r denotes the constant world net interest rate earned on bonds between periods t - 1 and t,

$\bar{y}_{T,t}$ is exogenously given quantity of tradables and τ denotes per capita taxes (in units of nontraded goods).

As the Ricardian equivalence holds in this framework, it is assumed that the government balances its budget each period. The government finances its purchases through lump-sum taxes and seigniorage. Under these assumptions, the government budget constraint, expressed in per capita terms and in units of nontraded goods, can be written as

$$G_t = \tau_t + \frac{M_t - M_{t-1}}{P_{N,t}} .$$

2.3 Optimality Conditions

The representative agent solves an intertemporal maximization problem, choosing the levels of consumption, money holding, bond holding and the output of nontraded goods that maximizes the discounted lifetime utility. To solve the first-order conditions for the representative agent, equation (7) is used to eliminate $p_{N,t}(z)$ from (8), and the utility function (1) is maximized subject to the resulting budget constraint. The optimal behaviour of the representative agent is characterized by the following optimality conditions (the indexes denoting the agents are dropped):

(9) $$\frac{C_{T,t+1}}{C_{T,t}} = \left(\frac{P_t / P_{T,t}}{P_{t+1} / P_{T,t+1}} \right)^{\sigma-\theta}$$

(10) $$\frac{C_{N,t}}{C_{T,t}} = \left(\frac{1-\gamma}{\gamma} \right) \left(\frac{P_{N,t}}{P_{T,t}} \right)^{-\theta}$$

(11) $$\kappa y_N^{\mu+1/\mu} = C_t^{-1/\sigma} \left(\frac{P_{N,t}}{P_t} \right) \left(\frac{\mu-1}{\mu} \right) \left(C_{N,t}^A + G_{N,t}^A \right)^{\frac{1}{\mu}}$$

(12) $$\frac{M_t}{P_t} = \left[\chi C_t^{1/\sigma} \left(\frac{1+i}{i} \right) \right]^{\frac{1}{\varepsilon}}$$

where i is the nominal interest rate defined by the Fisher identity

$$1 + i = (1+r) \frac{P_{T,t+1}}{P_{T,t}} .$$

Since the price of tradables also denotes the nominal exchange rate, the Fisher identity implies uncovered interest parity. Equation (9) is the Euler equation governing the optimal *intertemporal* allocation of tradables consumption. As noted by Dornbusch (1983), the relevant real interest rate, for a small country with a nontraded goods sector, is not the world interest rate but the interest rate stated in terms of the domestic consumption basket. For example, if the consumption-based price index is relative to the price of tradables is temporarily low relative to its future ratio the consumption-based real interest rate is also temporarily low.[3] This favours short-run over long-run consumption and raises short-run consumption with elasticity σ. However, as the consumption-based price index rises consumption of tradables becomes relatively dearer, and consequently consumption of tradables falls as a fraction of aggregate consumption with elasticity θ [recall equation (4)]. The interplay between σ and θ determines whether consumption of tradables raises or drops. Equation (10) governs the optimal *intratemporal* allocation of expenditures between traded and nontraded goods. The optimal allocation of expenditures depends on the openness of the economy, the relative price ratio and the elasticity of substitution between traded and nontraded goods. Equation (11) is the labour-leisure trade-off condition. It states that the marginal disutility of producing an extra unit of a nontraded good is equal to the marginal utility from consuming the added revenue that the extra unit of the nontraded good brings. Equation (12) is the money market equilibrium condition, which shows that the demand for real balances is a positive function of aggregate consumption and a negative function of the interest rate. It also shows that the demand of real money balances is influenced by the consumption elasticity of money demand ($1/\varepsilon$).

2.4 The Current Account

The current account is defined as the sum of the trade balance and the services balance. The trade balance is here the difference between the output of tradables and their

---

[3] In this case, the relative price of tradables in terms of the consumption-based price index falls in the long run. Then one unit of tradables borrowed at today has relatively much purchasing power in terms of aggregate consumption today and costs a little in terms of aggregate consumption upon the repayment of the loan next period. Since the loan adds more consumption today than it costs to repay tomorrow with the falling relative price of tradables the real interest rate in terms of aggregate consumption (the consumption-based real interest rate) is below the world interest rate. This argument directly follows Dornbusch (1983, 145).

consumption. The services account is here the product of the stock of real bonds and the world net interest rate earned on bonds. As standard in the literature, we consider the steady state in which the initial stock of net foreign asset is zero. The short-run current account identity, therefore, can be written as

(13) $$B_t = y_{T,t} - C_{T,t}\,.$$

Since the optimal intertemporal consumption of tradables is tilted by changes in the prices and the output of tradables is constant current account behaviour can be non-zero. This implies that fiscal expansion can generate current account imbalances, and the economy (the representative agent) either accumulates net foreign assets or issues foreign bonds in response to fiscal expansion.

It is assumed that the prices of nontraded goods are set one period in advance and that the economy reaches the new steady state after one period. The steady-state current account equation can be written as

(14) $$rB_t = C_{T,t+1} - C_{T,0}\,.$$

The current account imbalances in the short run determine the stock of net foreign assets in the steady state. Should an economic shock induce a current account deficit in the short run the economy must run a current account surplus in the steady state in order to finance its net foreign debt services. On the other hand, should the economy accumulate net foreign assets in the short run it uses interests earned on bonds for steady-state consumption of tradables.

2.5 A Symmetric Steady-State Equilibrium

Following Obstfeld and Rogoff (1995), the model is log-linearized around the flexible price steady state, in which all exogenous variables are constant and the initial stock of net foreign asset and government spending are both zero. In addition, we assume a symmetric equilibrium, in which all agents consume and produce the same amount of all differentiated nontraded goods and all prices are equal. In this symmetric equilibrium, equation (7) implies that the demand for nontraded goods is given by

(15) $$y_N = C_N + G_N\,.$$

The endowment of tradables is normalized such that the relative price of nontraded goods in terms of tradables is unity. In this symmetric steady state $y_{N,t} = (1-\gamma)C_t$, therefore the labour-leisure trade-off condition (11), can be solved to yield the steady-state output of nontraded goods

$$y_{N,0} = \left(\frac{\mu - 1}{\mu\kappa}\right)^{\frac{\sigma}{\sigma+1}} (1-\gamma)^{\frac{1}{1+\sigma}}.$$

This equation implies that due to monopolistic competition in the nontraded goods sector the output of nontraded goods is suboptimally low in the decentralised competitive equilibrium. As the elasticity of demand increases, the differentiated nontraded goods become closer substitutes, and consequently the monopoly power decreases.

2.6 The Log-Linear Version of the Model

As mentioned, the model is log-linearized around a symmetric steady state which was characterized above. The next step is to derive log-linear versions of all of the model's key equations. Each variable is expressed in percentage deviations from the initial (zero government spending) steady state. In the short run, nominal prices of nontraded goods are predetermined: they are set one period in advance and can be adjusted fully after one period. It follows from this assumption that it takes one period to reach the new steady state after a fiscal shock hits the economy. The short-run and steady state (long run) percentage changes are denoted as follows

$$\hat{x} = \frac{x_t - x_o}{x_0} \text{ and}$$

$$\hat{\hat{x}} = \frac{x_{t+1} - x_o}{x_0}.$$

The variables whose initial steady-state value is zero, government spending and foreign bond holdings, are normalized by appropriate initial consumptions: government spending is normalized by consumption of nontraded goods and net foreign assets by consumption of tradables.

We begin with the aggregate consumption index, equation (2). The log-linearized versions of it in the short run and in the steady state, respectively, are

(16) $\hat{C} = \gamma\hat{C}_T + (1-\gamma)\hat{C}_N$ and

(17) $\hat{\hat{C}} = \gamma\hat{\hat{C}}_T + (1-\gamma)\hat{\hat{C}}_N$.

The short-run stickiness of the prices of nontraded goods means that $\hat{P}_N = 0$. Hence, the log-linearized versions of the consumption-based price index (6) are

(18) $\hat{P} = \gamma\hat{P}_T$ and

(19) $\hat{\hat{P}} = \gamma\hat{\hat{P}}_T + (1-\gamma)\hat{\hat{P}}_N$.

The log-linearized versions of the demand curve for the representative agent, equation (15), are

(20) $\hat{y}_N = \hat{C}_N + \hat{G}_N$ and

(21) $\hat{\hat{y}}_N = \hat{\hat{C}}_N + \hat{\hat{G}}_N$.

The log-linearized version of the optimal intertemporal consumption of tradables, equation (9), is

(22) $\hat{C}_T - \hat{\hat{C}}_T = (\sigma - \theta)\left(\hat{P} - \hat{P}_T\right) - (\sigma - \theta)\left(\hat{\hat{P}} - \hat{\hat{P}}_T\right)$.

This equation illustrates that to the extent that shocks to the nontraded goods sector affect the relative price ratio (P, P_T) over time, they also affect the optimal time path of consumption of tradables and consequently the current account.

The log-linearized versions of the optimal allocation of expenditures between traded and nontraded goods link changes in consumption of traded and nontraded goods. Equation (10) takes the log-linear forms

(23) $\hat{C}_N - \hat{C}_T = \theta\hat{P}_T$ and

(24) $\hat{\hat{C}}_N - \hat{\hat{C}}_T = -\theta\left(\hat{\hat{P}}_N - \hat{\hat{P}}_T\right)$.

The assumption of sticky prices introduces a typical Keynesian feature into the model: Output becomes entirely demand-determined for a small enough rise in government spending. The labour-leisure trade-off condition, therefore, is required to hold only in the steady-run. Together, the log-linearized versions of equation (11) and the optimized relationship between C_N and C [equation (5)] imply

$$\frac{\mu+1}{\mu}\hat{\bar{y}}_N = \left(1-\frac{\theta}{\sigma}\right)\left(\hat{\bar{P}}_N - \hat{\bar{P}}\right) - \left(\frac{1}{\sigma}-\frac{1}{\mu}\right)\hat{\bar{C}}_N + \frac{1}{\mu}\hat{\bar{G}}_N . \tag{25}$$

The log-linearized versions of the money-demand equation (12), making use of the optimized relationship between C_T and C [equation (4)], can be written as

$$-\varepsilon\hat{P} = \frac{1}{\sigma}\hat{C}_T + \frac{\theta}{\sigma}\left(\hat{P}_T - \hat{P}\right) + \frac{1}{r}\left(\hat{P}_T - \hat{\bar{P}}_T\right) \text{ and} \tag{26}$$

$$-\varepsilon\hat{\bar{P}} = \frac{1}{\sigma}\hat{\bar{C}}_T + \frac{\theta}{\sigma}\left(\hat{\bar{P}}_T - \hat{\bar{P}}\right). \tag{27}$$

In equation (26) the real interest rate and the discount rate are tied down by the familiar condition

$$r = \frac{1-\beta}{\beta} .$$

Finally, the current account equations (14) and (15), given the constant endowment of tradables, take the log-linear forms

$$\hat{B} = -\hat{C}_T \text{ and} \tag{28}$$

$$r\hat{B} = \hat{\bar{C}}_T . \tag{29}$$

Equations (28) and (29) together imply that an increase (decrease) $\hat{B}$ in per-capita net foreign assets increases (decreases) steady-state consumption of tradables by the amount $\bar{r}\hat{B}$ since the output of tradables is exogenous.

Equations (16) – (29) fully describe the equilibrium dynamics of the model. Having laid out the equations of the model, we now turn to the analysis of the effects of fiscal expansion.

3 The Effects of Fiscal Expansion: A Special Case

The log-linear equations would allow us to solve for closed-form solutions for the short-run and steady-state effects of fiscal expansion.[4] However, a numerical solution of the model can be used to illustrate the effects of fiscal expansion. Nonetheless, we, for a start, solve for an analytical solution of the model in a simple special case. To simplify the analysis we assume a logarithmic utility for consumption and real money balances, which corresponds to $\varepsilon = \sigma = 1$. In addition, we assume that the elasticity of substitution between traded and nontraded goods is also unity ($\theta = 1$).

In the case where $\theta = \sigma = 1$, as pointed out by Lane (2001a), the utility function is log-separable in consumption of traded and nontraded goods. Equation (21) reveals that in this case the optimal intertemporal profile of tradables consumption is perfectly flat. Since the output of tradables is constant and initial net foreign assets are zero the economy has always a balanced current account regardless of shock to the output or consumption of nontraded goods.

Together the steady-state market clearing condition for nontraded goods (21) and the labour-leisure trade-off condition (25) imply that

(30) $\hat{\bar{C}}_N = -\frac{1}{2}\hat{\bar{G}}_N$ and

(31) $\hat{\bar{y}}_N = \frac{1}{2}\hat{\bar{G}}_N$.

The steady-state output of nontraded goods increases as the agents respond to a rise in government spending by substituting into work out of leisure. Consequently, private consumption falls by less than the rise in government spending.

Substitution (30) into the log-linearized version of the money demand function that makes use of the optimized relationship between C_N and C [equation (5)][5] yields to

---

[4] Lane (2001a) used this solution technique to solve for the effects of an exogenous rise in the money supply.

[5] The money demand function can be now written as $\frac{M_t}{P_t} = \frac{\chi}{(1-\gamma)}\frac{P_{N,t}}{P_t}\left(\frac{1+i}{i}\right)C_{N,t}$.

(32) $$\hat{\bar{P}}_N = \frac{1}{2}\hat{\bar{G}}_N .$$

The preceding equation indicates that a rise in government spending raises the nontraded goods price index. Higher government spending leads to an outward shift in the demand curve facing the agents, therefore allowing them to raise their prices. Furthermore, the rise in the price index is proportional to that in the output of nontraded goods.

Substituting equations (30) and (32) into equation (23) yields to

(33) $$\hat{\bar{P}}_T = 0 .$$

The startling implication of this equation is that a rise in government spending does not affect the nominal exchange rate in the steady state (the price of tradables also denotes the nominal exchange rate). The economic intuition behind this result is the following: the allocation of total consumption spending between traded and nontraded goods implies that in an optimal case the ratio of marginal utilities of traded and nontraded goods equals the relative price of tradables in terms of nontraded goods. Consumption of tradables does not change, consequently the marginal utility of tradables consumption is constant. The fall in nontraded goods consumption increases the marginal utility of nontraded goods consumption. Therefore, an adjustment in the relative price ration is needed in order to maintain the allocation of total consumption in optimum. As shown, a rise in government spending raises the price of nontraded goods and crowds out nontraded goods consumption. These effects guarantee that the ratio of marginal utilities equals the relative price ratio without an adjustment in the price of tradables.

Together, the rise in the nontraded goods price index and the unaffected price of tradables have two consequences. Firstly, the steady-state change in the consumption-based price index (21) is determined by the rise in the nontraded goods price index and the share of nontraded goods in total consumption. Secondly, a rise in government spending appreciates the equilibrium real exchange rate which is defined as the price of tradables in terms of nontraded goods. Defined this way the equilibrium real exchange rate represents an internal terms of trade measuring how much of nontraded goods must be given up for one unit of tradables in the steady state. Since a rise in government spending appreciates the equilibrium real exchange rate, it thus improves the economy’s steady-state terms of trade.

The next step is to solve for the short-run effects of a rise in government spending. Substituting the market clearing condition (20) into the money market equilibrium condition that makes use of the optimized relationship between C_N and C yields to

(34) $\hat{C}_N = 0$.

Substituting this equation into (20) yields to

(35) $\hat{y}_N = \hat{G}_N$.

This equation clearly shows that a rise in government spending increases the output of nontraded goods. Furthermore, in this special case the "balanced budget multiplier" is exactly one in the short run. Since a rise in government spending increases output on a one-to-one basis it does not crowd out private consumption, as equation (34) illustrates.

Since consumptions of traded and nontraded goods are both unaffected, equation (22) shows that

(36) $\hat{P}_T = 0$.

A rise in government spending, as the preceding equation brings out, does not affect the nominal exchange rate in the short run. This is a consequence of two factors. Firstly, a rise in government spending does not affect money demand. The money demand function (12) shows that in the case where $\varepsilon = 1$ the short-run money demand is proportional to aggregate consumption. Since aggregate consumption does not change the unaffected money demand leaves the nominal exchange rate unaffected. Secondly, since neither traded nor nontraded goods consumption changes the ratio of marginal utilities of traded and nontraded goods equals the relative price ratio without an adjustment in the price of tradables.

4 The Effects of Fiscal Expansion: The General Case

4.1 The Solution of the Model

The log-linear equations would allow us to solve for closed-form solutions of the model also in the general case. Alternatively, a numerical solution of the model can be used to illustrate, in a tractable way, the effects of a rise in government spending. Seven short-run and seven steady-state variables are to be determined. Fourteen equations that jointly determine them are (16) – (29). In order to solve the model numerically, it can be written in the matrix form Ax = B, where the matrix A (14 x 14) contains the structural parameters of the equations, the vector x (14 x 1) contains the endogenous variables of the equations and the vector B (14 x 1) contains the exogenous shock (a rise in government spending). In this case, the model can be solved by using linear algebra, as the solution of the model can then be written as $x = A^{-1}B$.

4.2 Calibration of the Model

In order to solve the model numerically, values for six parameters are required: the intertemporal elasticity of aggregate consumption, the share of tradables in total consumption, the consumption elasticity of money demand, the elasticity of substitution between traded and nontraded goods, the elasticity of substitution between varieties of nontraded goods and the real interest rate. We focus attention on how the effects of fiscal expansion depend on the marginal rate of substitution between traded and nontraded goods. This parameter, therefore, is not restricted to a particular value, but it is analyzed how the solution of the model depends on this parameter value. We let this elasticity of substitution to be between 0.4 and 4.[6] In the calibration, it is assumed a logarithmic utility for consumption, which corresponds to $\sigma = 1$. This is a standard assumption, and one that would render the model compatible with a balanced growth path if trend technological progress was introduced (see e.g. King, Plosser and Rebelo 1988). Stockman and Tesar (1995) estimated that nontraded goods make up about half of output, and thus γ is set to 0.5. Mankiw and Summers (1986) estimated the consumption elasticity of money demand ($1/\varepsilon$ in this model) to be very close unity, so it is chosen a value $\varepsilon = 1$. The elasticity of substitution between varieties of nontraded goods is set to 6, which implies a 20 percent mark-up in the steady state. This is consistent with the mark-up estimated by Rotenberg and Woodford (1992) and it is widely used in related work. Finally, the real interest rate is chosen to be 4 percent.

---

[6] There is limited evidence on this elasticity of substitution in the empirical macroeconomics literature. Mendoza (1991) estimate this elasticity of substitution to be 0.74, Ostry and Reinhart (1992) report estimates in the range of 0.66 to 1.3 (for developing countries) and Stockman and Tesar (1994) find an estimate as low as 0.44.

4.3 The Effects of a Permanent Rise in Government Spending

Figures 1 and 2 illustrate the effects of a 1 percent rise in government spending (relative to initial consumption of nontraded goods)[7]. In all diagrams, the horizontal axis marks the elasticity of substitution between traded and nontraded goods and the vertical axis marks the variable's percentage deviation from the initial steady state.[8] To illuminate how the interplay between σ and θ influences the current account and nominal exchange rate responses to a rise in government spending, three cases can be distinguished to consider: (i) $\theta = \sigma = 1$, (ii) $\theta > \sigma = 1$ and (iii) $\theta < \sigma = 1$.

In case (i) the solution of the model corresponds to the special case that was presented in Section 4. Figure 1 indicates the result that a rise in government spending affects nothing other than the output of nontraded goods on a one-to-one basis leaving all other variables unaffected in the short run. As mentioned, in the case where $\theta = \sigma = 1$ the utility function is log-separable in consumption of traded and nontraded goods. In this case the optimal intertemporal profile of tradables consumption is perfectly flat, as the intra- and intertemporal substitution effects cancel out each others. Therefore, although a rise in government spending affects the relative price ratio (P, P_T) in the steady state this price ratio change has to influence on consumption of tradables and consequently on the current account. As noted previously, in the case where $\varepsilon = 1$ the short-run money demand is proportional to aggregate consumption, therefore the unchanged money demand leaves the nominal exchange rate unaffected. Figure 2 illustrates that in the steady state a 1 percent rise in government spending, among others, increases the output of nontraded goods by a half percent and raises the nontraded goods price index by a half percent as equations (31) and (32) indicate, respectively.

In case (ii), as can be seen from Figure 1, a rise in government spending increases nontraded goods consumption and production, decreases tradables and aggregate consumption, depreciates the nominal exchange rate and induces a current account

---

[7] In the case of a permanent increase $\hat{G}_N = \hat{\overline{G}}_N = 1$.

[8] As noted previously, the model is log-linearized around the steady state, in which net foreign assets holdings is zero and the change in net foreign assets is normalized by consumption of tradables. The current account diagram, therefore, shows by how much the current account changes relative to initial consumption of tradables. In addition, the real exchange rate is defined as the relative price of tradables in terms of nontraded goods.

surplus in the short run. Since the short-run money demand is proportional to aggregate consumption a fall in aggregate consumption tends to lower money demand requiring a depreciation of the nominal exchange rate in order to maintain equilibrium in the money market. This depreciation and the sticky prices in the nontraded goods sector imply that the relative price of tradables rises, which encourages the agents to switch their consumption towards nontraded goods. The strength of this effect depends on the intratemporal elasticity of substitution between traded and nontraded goods. On the other hand, since the aggregate price level relative to the price of tradables is currently low relative to its future ratio, the consumption-based real interest rate is temporarily low. This low consumption-based real interest rate induces the agents to switch consumption from the future to the present. The strength of this effect depends on the intertemporal elasticity of substitution. The intra- and intertemporal substitution effects on short-run consumption of tradables pull in opposite directions. Since $\theta > \sigma$, the intratemporal substitution effect wins out and consequently consumption of tradables decreases. This reduction in consumption of tradables in turn induces a short-run current account surplus, which implies a permanent improvement in the economy's net foreign assets. In the steady state this entails a permanent services balance surplus, which is used to finance a trade balance deficit. This trade balance deficit allows consumption of tradables to remain permanently above the endowment of tradables. Nonetheless, the raise in steady-state consumption of tradables is fairly small.

In case (iii), a rise in government spending, contrary to the previous case, appreciates the nominal exchange rate, increases tradables and aggregate consumption and generates a current account surplus in the short run. Interestingly, a one percent rise in government spending increases the output of nontraded goods by more than one percent in spite of the appreciation of the nominal exchange rate. Increased aggregate consumption raises money demand, which tends to raise the interest rate. An appreciation of the nominal exchange rate, therefore, is required to balance money demand and supply. This appreciation raises the relative price of nontraded goods, which favours substitution from traded to nontraded goods. However, this negative effect on consumption of nontraded goods is more than offset by the positive effect. As in the previous case, also in this case the aggregate price level relative to the price of tradables is currently low relative to its future value. The consumption-based real interest rate, therefore, is temporarily low, which induces the agents to switch consumption from the steady state to the short run thus also increasing consumption of nontraded goods. Since θ is now low, implying little substitutability in consumption between traded and nontraded goods, the relative strength of the intertemporal substitution is low. The intratemporal effect, therefore, dominates increasing consumption of nontraded goods in spite of the appreciation of the nominal exchange rate. From the above discussion, it should be clear that the intratemporal and intertemporal substitution effects increase consumption of tradables thereby generating a short-run current account deficit. This in turn induces a permanent reduction in net foreign assets. In the steady state this entails a permanent services balance deficit, which must be financed by a trade balance surplus. In order to achieve a trade balance surplus, consumption of tradables must remain permanently below the endowment of tradables.

Figure 2 illustrates that a rise in government spending raises the steady-state output of nontraded goods. Output raises as the agents respond to a rise in government spending by substituting into work out of leisure. There can be, in some cases, negative effects on labour supply, as explained in a moment, but they are more then offset by the positive effects. Consequently, consumption of nontraded goods falls by less than the rise in government spending. As stressed by Lane (2001a), net foreign assets have effects on the level of desired consumption of nontraded goods and on the optimal labour supply, and these effects on the output of nontraded goods pull in opposite directions. Firstly, due to the nonseparability between traded and nontraded goods consumption the change in steady-state consumption of tradables affect the desired consumption of nontraded goods. For example, in the case where $\theta < \sigma$ the declined steady-state consumption of tradables induces a decline in desired consumption of nontraded goods, which tends to lower the output of nontraded goods. However, this effect plays only a minor role here since output raises by the most in the case where this effects tends to reduce output. Secondly, short-run current account imbalances have a wealth effect on the optimal labour supply: As equation (11) shows, higher consumption induces a reduction in labour supply. Therefore, if the economy accumulated net foreign assets in the short run, higher wealth leads to some reduction in labour supply. For this reason, output raises by less than in the case where the current account remained in balance in the short run. On the other hand, if a rise in government spending generated a current account deficit, lower wealth leads to some increase in labour supply and output.

As Figure 2 illustrates, a rise in government spending appreciates the equilibrium real exchange rate and raises the nontraded goods price index in the steady state. Higher government spending leads to an outward shift in the demand curve facing the agents, therefore allowing them to raise their prices. Furthermore, this rise in the price index is proportional to the rise in the output of nontraded goods. In the steady state, as before, a rise in government spending appreciates the nominal exchange rate appreciates if $\theta < \sigma$. Indeed, the nominal exchange rate jumps immediately to its steady-state level despite the stickiness of the prices of nontraded goods in the short run.[9] The equilibrium real exchange rate was defined as the price of tradables in terms of nontraded goods. As Figure 2 illustrates, a rise in government spending appreciates the equilibrium real exchange rate, improving the economy's steady-state terms of trade. The change in the equilibrium real exchange rate is required to lead the agents to revise their consumption allocation between traded and nontraded goods in a consistent way. Since the steady-state trade balance needs to change to reach a particular value, the equilibrium exchange rate has to change accordingly. It has to appreciate adequately to induce the agents to change their consumption allocation in a way consistent with the required change in the steady-state trade balance.

4.4 The Effects of a Temporary Rise in Government Spending

We now turn to examining the effects of a temporary rise in government spending. A temporary rise in government spending is assumed to last for one period, and as before, the price of nontraded goods are sticky in short run and the economy reaches the new steady state after one period.[10] A temporary rise in government spending can have effects on the steady state, because of induced wealth changes through short-run current account imbalances. If fiscal policy induced short-run wealth changes, these changes would to affect the optimal labour supply and output in the steady state. Consequently, fiscal policy would affect the economy well beyond the time frame of a temporary rise in government spending.

[9] As later shown, exchange overshooting (undershooting) takes place if ε is bigger (smaller) than one.

[10] In the case of a temporary increase $\hat{G}_N = 1$ and $\hat{\bar{G}}_N = 0$.

Surprisingly, a one percent temporary rise in government spending raises the short-run output of nontraded goods by one percent (for all values of the elasticity of substitution between traded and nontraded goods consumption) but it leaves all other endogenous variables unaffected both in the short run and in the steady state. Therefore, even though a temporary rise in government spending induces a tilt into the time profile of aggregate demand, it does not introduce a tilt in the time profile of output net of government consumption. It is interesting to notice that the effects of a rise in government spending in the short run differ largely depending on whether a rise government spending is permanent or temporary.

The intuition behind the result, that a temporary rise in government spending affects nothing other than the short-run output of nontraded goods, is rather straightforward. Together unaffected consumptions of traded and nontraded goods imply that the unchanged pressure on money demand leaves also the nominal exchange rate unaffected. With the nominal exchange rate been unchanged and the price of nontraded goods fixed, the relative price ratio (P, P_T) also remains constant in the short run. Again, this relative price ratio remains constant also in the steady state. A temporary rise in government spending does not affect this price ratio either today or tomorrow and consequently the optimal intertemporal profile of consumption of tradables is perfectly flat for all values of the elasticity of substitution between traded and nontraded goods. The constant consumption of tradables has two implications. Firstly, with no effect on consumption of tradables the assumption that the government spends exclusively on nontraded goods isolates the shock to the nontraded goods sector and thus the short-run output of nontraded goods raises on a one-to-one basis. Secondly, a temporary rise in government spending does not induce short-run current account imbalances that would affect the optimal labour supply and output in the steady state. Fiscal policy, therefore, does not affect the economy beyond the time frame of a temporary rise in government spending.

4.5 Sensitivity Analysis: The Role of Openness and Money Demand

In this section, we explore to what extent the effects of a rise in government spending represented above may be sensitive to the calibration of two central parameters characterizing the small open economy: the degree of openness and the consumption elasticity of money demand. To begin with, we can discover that changing these parameters does not influence the effects of temporary fiscal expansion.

Figure 3 illustrates the consequences of changing the share of tradables in total consumption to 0.2. As can be seen from Figure 3, a rise in government spending induces a smaller effect on the output of nontraded goods and a larger effect on tradables consumption in the more closed economy in the short run. The main reason behind these changes is the change in the nominal exchange rate. The greater change in the nominal exchange rate causes greater intratemporal consumption switching which increases tradables consumption and decreases nontraded goods consumption relative to the baseline case. Due to the change in tradables consumption, the current account alters by less in the more open economy. However, one should recall that the current account is normalized by initial consumption of traded goods. Hence, a rise in government spending influences the current account, relative to total consumption, by more in the more open economy. Since the share of tradables in total consumption is low, the wealth effect due to current account imbalances induces a smaller effect on the optimal labour supply than in the baseline case. Figure 4 also illustrates that the degree of openness has little influence on the equilibrium real exchange rate.

Finally, we explore the consequences of changing the consumption elasticity of money demand. This elasticity is critical for the response of the nominal exchange rate. Helliwell, Conkerline and Lafrance (1990) estimate a large number of money demand elasticises for G7 countries. The estimates of money demand elasticises suggests that $\varepsilon > 1$, and thus we change to this parameter to 1.5.

Figures 4 and 5 illustrate the consequences of changing the consumption elasticity of money demand. It emerges from the Figures that this parameter has the biggest influence on the nominal exchange rate and the short-run output (and consumption) of nontraded goods. In this case, the nominal exchange rate depreciates if $\theta > 1.5$. In general, the nominal exchange rate always depreciates in the short run if $\varepsilon > \theta$, and appreciates if $\varepsilon < \theta$. Due to the smaller rise in the output of nontraded goods aggregate consumption is lower than in the baseline case. This has its own effect on money demand; however, the main reason for the different exchange rate response to a rise in government spending is the altered consumption elasticity of money demand. The higher ε induces higher demand for real money balances, and the nominal exchange has to change accordingly to balance money demand and supply. The change in the nominal exchange rate leads up to intratemporal consumption substitution. Anyway, the main reason for the lower rise in output is the increased demand for real money balances which thus decreases consumption of nontraded goods.

Figures 4 and 5 also illustrate that the change in the consumption elasticity of money demand has only a modest effect on the current account and an infinitesimal effect on steady-state output and the real equilibrium exchange rate. Due to the small change in tradables consumption the current account changes only by little relative to the baseline case. Thus, the change in wealth causes only an infinitesimal effect on the optimal labour supply in the steady state. Although the consumption elasticity of money demand affects the nominal exchange rate in the steady state it has only an infinitesimal effect on the real equilibrium exchange rate. In addition, monetary equilibrium requires overshooting of the nominal exchange rate. Generally, overshooting takes place if $\varepsilon > 1$, which is the same overshooting condition as in the small-country monetary policy model by Obstfeld-Rogoff (1995, Appendix; 1996, 689-694).

As the analysis above shows, temporary and permanent changes in government spending have different effects in the short run. In the baseline case ($\varepsilon = 1$), a permanent rise in government spending raises output more than a temporary one (unless $\theta = 1$), where as in the case of $\varepsilon = 1.5$ the opposite result is more likely. In closed economy models, Hall (1980) argue that temporary changes in government spending have larger effects than permanent ones, as against e.g. Aiyagari, Christiano and Eichenbaum (1992) and Baxter and King (1993) find the opposite result. In the above-mentioned models, the main reason behind the result that the effects of permanent changes have larger effects is that they cause a larger increase in investment in the short run. In this model, the optimal consumption response alone explains why permanent changes might have bigger effects that temporary ones.

It is also worth observing that the findings on the output effects of a rise in government spending are rather consistent with the range of multipliers obtained using a variety of macroeconometric models. Hemming, Kell and Mahfouz (2002) survey the empirical literature on the effectiveness of fiscal policy. They conclude that “[t]he range of estimated short-run multipliers is wide, (…), but most expenditure multipliers are in the range 0.6 to 1.4." The results surveyed by the authors also support the view that long-run multipliers are smaller that short-run multipliers.

5 Summary and Concluding Remarks

This paper analyzes the macroeconomic effects of fiscal policy in a model of a small open economy, building on the monetary policy model by Lane (2001a). The analysis of this paper shows that the effects of fiscal policy, under a flexible exchange rate regime, largely depend on the substitutability between traded and nontraded goods. One advantage of the fully dynamic model is that is allows fiscal policy to induce tilts into the time profile of output and relative prices. Two factors determine the extent to which changing relative prices affect consumption. One is the intratemporal elasticity of substitution between traded and nontraded goods and the other is the intertemporal elasticity of consumption. The results demonstrate that the interplay between these two elasticities determines the sign of the current account response to fiscal policy. If the intertemporal elasticity exceeds (is below) the intratemporal elasticity, fiscal expansion induces a rise (reduction) in tradables consumption and thus generates a current account deficit (surplus). These results are in line with Lane's conclusions (2001a), since the sign of the current account response to monetary expansion depends on the same condition. These results are also consistent with the findings of Obstfeld and Rogoff (1996, 232–235), reaffirming the claim that the interplay between these two elasticises determine the current account response to other economic disturbances.

This paper shows that the nominal exchange rate depreciates (appreciates), in the short run, if the inverse of the consumption elasticity of money demand is greater (smaller) than the elasticity of substitution between traded and nontraded goods. At the same time, as suggested by Obstfeld and Rogoff (1995, 1996), exchange rate overshooting occurs if the inverse of the consumption elasticity of money demand is greater than one. In addition, fiscal policy always appreciates the equilibrium real exchange rate.

The model brings out a positive view on the effectiveness of fiscal policy in a small open economy under a flexible exchange rate regime. This study reveals that, under a specific parameterization, a one percent permanent rise in government spending increases the output of nontraded goods by at least one percent in the short run. Moreover, it is shown that fiscal expansion increases output by more than one percent also in the situation where the nominal exchange rate appreciates. Notwithstanding the appreciation of the nominal exchange rate, output rises because a change in relative prices induces consumers to choose a profile of consumption that is tilted towards the present. Open economy models in which a rise in government spending does not lead to any tilting into the time profile of relative prices and the consumption-based real interest rate do not allow for this effect.

References

AIYAGARI, S. R. – CHRISTIAN, L. J. – EICHENBAUM, M. (1992): The Output, Employment, and Interest Rate Effects of Government Consumption. Journal of Monetary Economics 30, 73–86.

BAXTER, M. – KING, R. G. (1993): Fiscal Policy in General Equilibrium. American Economic Review 83, 315–334.

DORNBUSCH, R. (1983): Real Interest Rates, Home Goods, and Optimal External Borrowing. Journal of Political Economy 91, 141–153.

HALL, R. E. (1980): Labor Supply and Aggregate Fluctuations. In BRUNNER, K – MELTZER, A. H. (eds.) On the State of Macroeconomics. Carnegie-Rochester Conference Series on Public Policy XII. Amsterdam, North Holland.

HEMMING, R. – KELL, M. – MAHFOUZ, S. (2002): The Effectiveness of Fiscal Policy in Stimulating Economic Activity – A Review of the Literature. IMF Working Paper No. 208.

HELLIWELL, J. – CONKERLINE, J. – LAFRANCE, R. (1990): Multicountry Modelling of Financial Markets. In HOOPER, P. (ed.) Financial Sectors in Open Economies: Empirical Analysis and Policy Issues. Washington, Federal Reserve Board.

KIM, S. – ROUBINI, N. (2004): Twin Deficit or Twin Divergence? Fiscal Policy, Current Account, and Real Exchange Rate in the US. Econometric Society 2004 North American Winter Meeting, Paper No. 271.

KING, R. G. – PLOSSER, C. – REBELO, S. T. (1998): Production, Growth and Business Cycles: I. the Basic Neoclassical Model. Journal of Monetary Economics 21, 195–232.

LANE, P. (2001a): Money Shocks and the Current Account. In CALVO, G. – DORNBUSCH, R. – OBSTFELD, M. (eds.) Money, Capital Mobility and Trade: Essays in Honor of Robert Mundell. Cambridge, MIT Press.

LANE, P. (2001b): The New Open Economy Macroeconomics: A Survey. Journal of International Economics 54, 235–266.

MANKIW, N. G. – SUMMERS, L. H. (1986): Money Demand and the Effects of Fiscal Policies. Journal of Money, Credit and Banking 18, 415–429.

MENDOZA, E. (1991): Real Business Cycles in a Small Open Economy. American Economic Review 81, 797–818.

OBSTFELD, M. – ROGOFF, K. (1995): Exchange Rate Dynamics Redux. Journal of Political Economy 103, 624–660.

OBSTFELD, M. – ROGOFF, K. (1996): Foundations of International Macroeconomics. MIT Press, Cambridge.

OSTRY, J. D. – REINHART, C. M. (1992): Private Saving and Terms of Trade Shocks: Evidence from Developing Countries. IMF Staff Papers 39, 495–517.

PIERDZIOCH, C. (2004): Lecture Notes on the New Open Economy Macroeconomics. Unpublished.

ROTEMBERG, J. – WOODFORD, M. (1992): Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity. Journal of Political Economy 100, 1153–1207.

STOCKMAN, A. C. – TESAR, L. L. (1995): Tastes and Technology in a Two-Country Model of the Business Cycle: Explaining International Comovements. American Economic Review 85, 168–185.

TERVALA, J. (2004): The Effects of Fiscal Policy in a Small Open Economy: The Role of Useful Government Spending. University of Helsinki, Department of Economics Discussion Paper No. 611.

Figure 1. The effects of a permanent rise in government spending

The horizontal axis marks the elasticity of substitution between traded and nontraded goods and the vertical axis marks the variable's percentage deviation from the initial steady state.

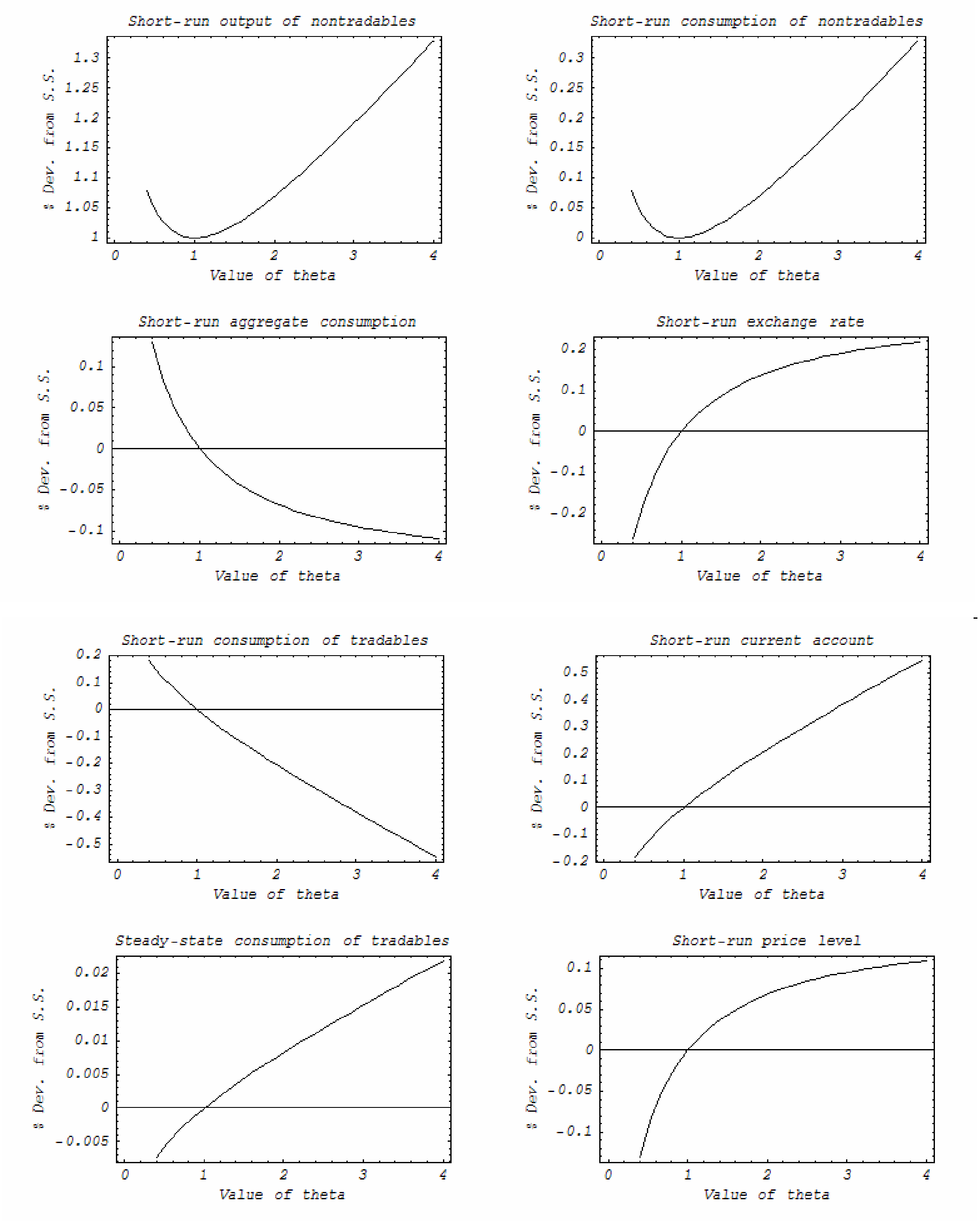

Figure 2. The effects of a permanent rise in government spending

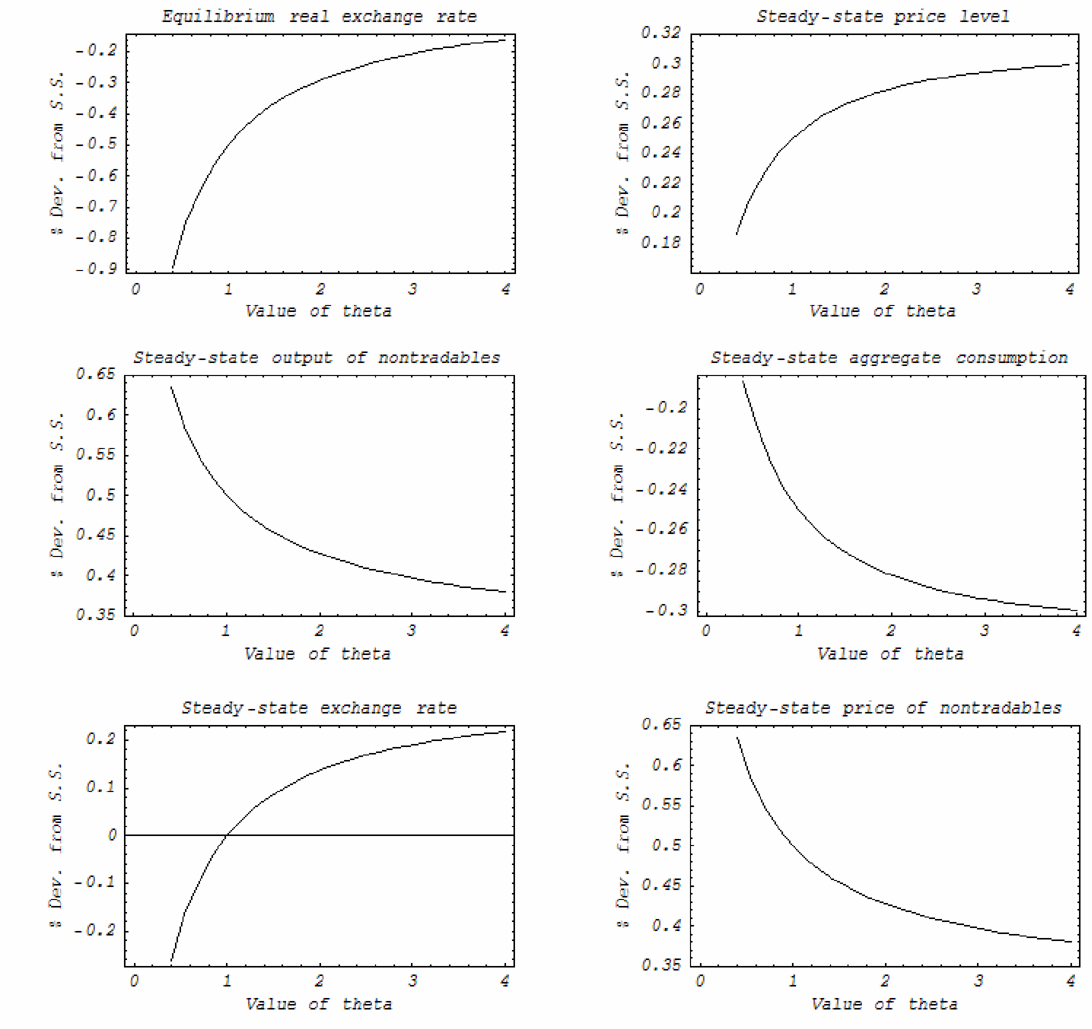

Figure 3. Sensitivity analysis, the role of openness

The solid line γ = 0.5, the dashed line γ = 0.2

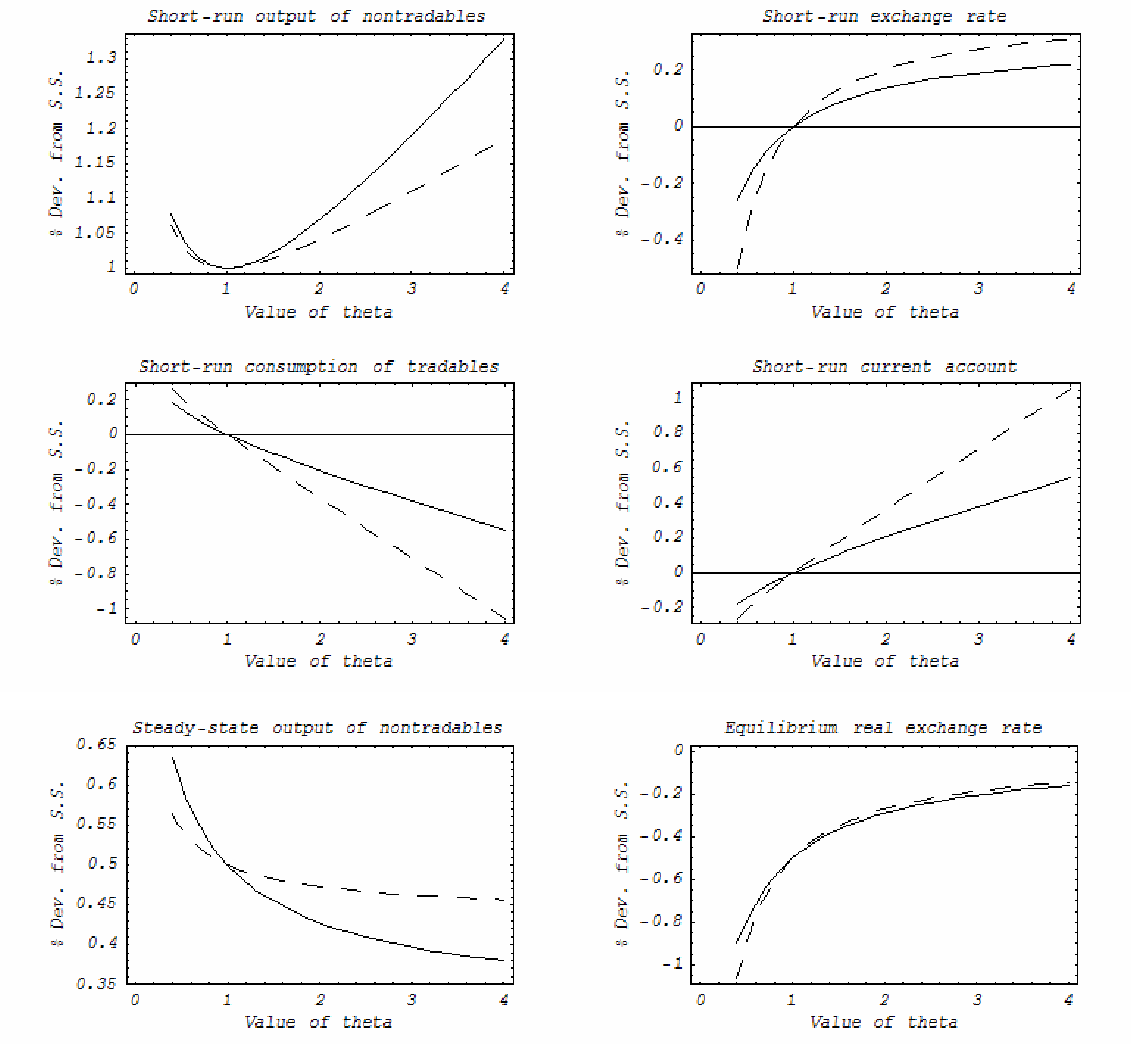

Figure 4. Sensitivity analysis, the role of money demand

The solid line ε = 1, the dashed line ε = 1.5

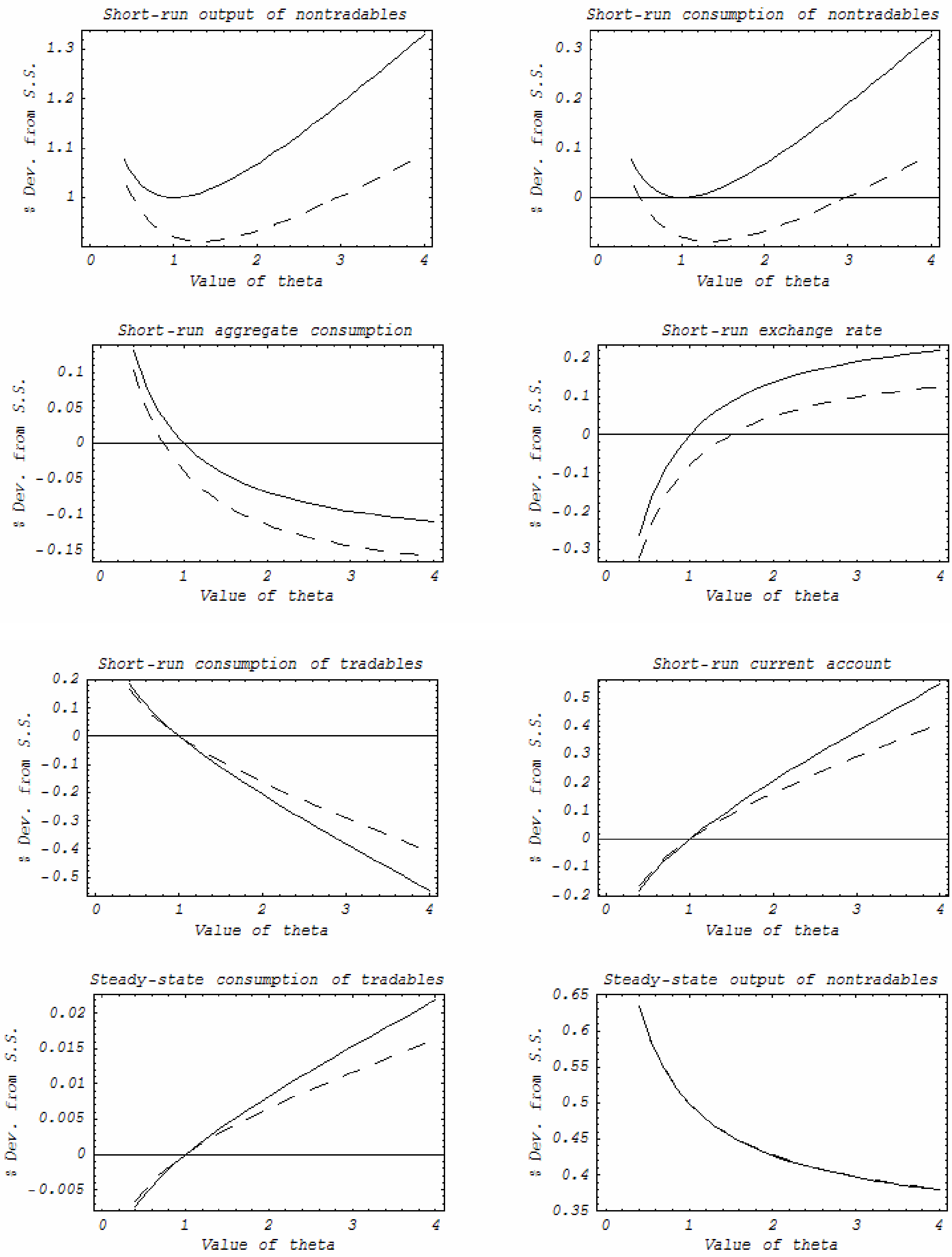

Figure 5. Sensitivity analysis, the role of money demand

The solid line ε = 1, the dashed line ε = 1.5